ICE ARCHIVES

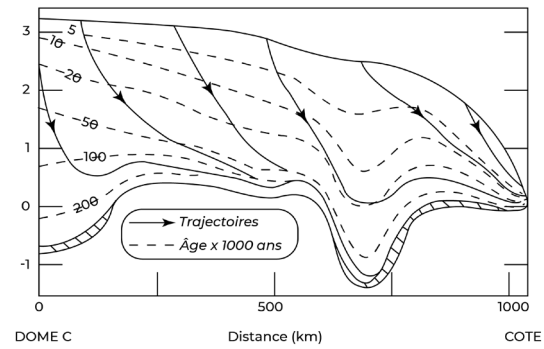
The Polar POD will navigate in an ocean whose level has not always been the same over the past millennia and around this fantastic ice continent, a library of climate memories. The members of the expedition will breathe an air whose dust, temperature and composition will be preserved for centuries to come in the ice of the polar cap.

- Des strates annuelles
- Des carottages de 2 000 m
- 150 000 ans de climat retrouvés

WHAT YOU SHOULD KNOW :

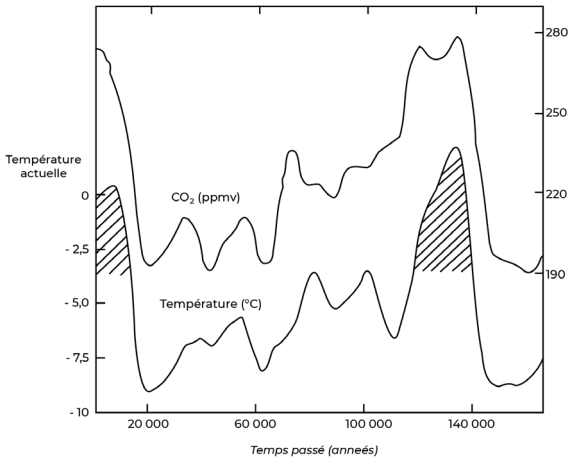
Snow accumulates and compresses on the surface of the ice sheet season after season. The ice crystals of the flakes form in the clouds around various "dust" (aerosols) that they carry in their fall. These include natural smoke (volcanoes) or artificial smoke (industry, combustion ...), dust raised in deserts, and even pollen or sea salts (sea spray). When snow covers the ground, air is trapped between the flakes; it then forms tiny bubbles inside the ice, which become increasingly rare at depth (the air diffuses between the crystals by overpressure). Once trapped, this air retains the composition it had at the time of the snowfall. Moreover, the quantity of gas retained in the bubbles depends on the altitude at which the air was trapped. But that's not all: physicists, who know that the same chemical element is in fact a natural mixture of several "brother-atoms" called isotopes, have discovered that the oxygen isotopes (018 and 016) that make up the water molecules in ice crystals, are in different proportions depending on the temperature at which the flakes were formed.

Digging in the ice is a way to go back in time. Estimating the isotope ratios 018/016, identifying the trapped aerosols, analyzing the air trapped in the bubbles at all depths of the ice cap, therefore, means knowing the earth's temperature, the altitude (i.e. thickness) of the ice cap and the constituents of the atmosphere, well beyond the 70 years of modern meteorological measurements made by humans. The "ice archive" preserves the past fluctuations of the Earth's climate over more than 1,000,000 years! We can see the ice ages, the warming, the droughts or the volcanic catastrophes that our prehistoric ancestors experienced! These paleoclimatological studies, which are extremely meticulous, are not just an intellectual curiosity: they are essential for developing a model that will allow us to predict future climate changes according to human impacts (excess carbon dioxide, methane, etc.). To date the most superficial layers, glaciologists count the more or less dense strata left by summer



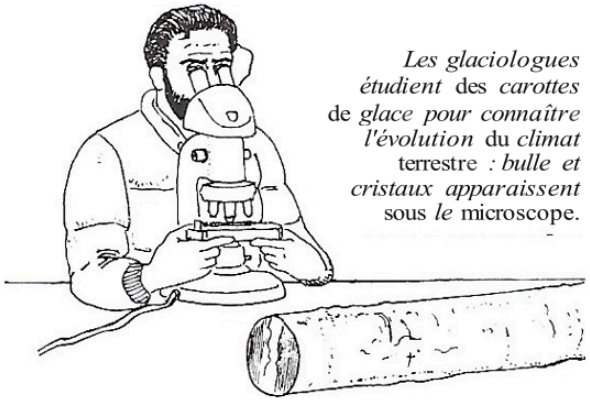
Section of the ice cap showing the flow of the ice, from Dome C to the coast of Terre d'Adélie.

Taking ice at -50°C is not easy. A 10-meter well, cleared as sterile as possible to avoid contaminating the samples, allows access to a hundred years. Trains of tubes with rotating or heating heads cut and bring up cylinders of ice (cores). But it is very difficult to prevent the drill hole from jamming the core barrel when it closes. At 100 meters, we are at -1,000 years, and beyond a thousand meters, we are approaching the layers of the last glaciation. To reach 2,000 meters, the coring work can last for years.



For 150,000 years, variations in global temperature have been correlated with those in the carbon dioxide contained in the atmosphere, according to the study of the Vostok ice core.

And the past climate is apparent from the cores. During the glacial maximum of 18,000 years ago, the Earth's temperature was 7°C lower than it is today. During this time, 20 times more dust circulated in the sky, not due to volcanic eruptions as was long thought, but to sandy winds on arid continents. On the other hand, carbon dioxide (a "greenhouse effect" gas) had dropped, at the same time, to 2/3 of the current value. We also find the climatic variations linked to the astronomical fluctuations of the earth's orbit around the sun (periods of 100,000, 20,000 and 10,000 years) called Milankovitch cycles.



Les glaciologues étudient des carottes de glace pour connaître l'évolution du climat terrestre : bulle et cristaux apparaissent sous le microscope.

Chronology of famous cores :

- Years -70: First coring at Dome C that goes back over 20,000 years of climate history
- 1984-1985: Vostok coring
- Years 2000: EPICA at Dome C over 800,000 years of history
- 2022: Beyond EPICA: at Little Dome C. Ice core 2730 meters thick over 1.5 million years of history

Les Américains ont carotté 2 160 m de glace à la station Byrd en 1968, les Français 905 m au Dôme C en 1978, et les Soviétiques étaient à la côte - 2 545 m à Vostok en 1989 : plus de 150 000 ans d'archives glaciaires mises à jour !

SUGGESTED ACTIVITIES

The ice archives

- What marks of the past can the ice cap conceal in its depths ?
- Where can we expect to find the oldest ice (estimated to be over 500,000 years old) ?
- What is the advantage of coring in Antarctica compared to Greenland ?

FOR MORE DETAILS

Books :

- Glaces de l'Antarctique - C. Lorius.
- La Voix des pôles - L. Lescarmontier.
- Vostok, le dernier secret de l'Antarctique - JR Petit.